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UH-1 DOOR GUNNER PROTECTION

by

Benjamin F. Wood
Mobility Branch

March 1974

Final Report

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A cold weather protection kit for door gunners and crew was developed for the UH-1D/H helicopter. The kit consists of a bulkhead and sliding doors which permits the gunner's compartment to be partitioned from the rest of the aircraft interior. The gunner is dressed in clothing to provide him sufficient protection while the rest of the crew and passengers are not exposed. Several clothing ensembles were tested. The kit and two sets of cold weather clothing were evaluated in Alaska. The evaluation was favorable, except for comments

(CON'T ON REVERSE)

that the door gunners were too warm when the doors were closed, and litter and passenger capacity were affected.

In considering the possible need for the door gunner kit as standard Army equipment, the Training and Doctrine Command examined the doctrinal aspects of the problem and stated that door gunners on UH-1D/H aircraft will only be required on a limited number of missions in a front line type of conflict, that the duration of their exposure will be brief, and that in a cold environment crew members as well as passengers in a UH-1D/H should be dressed for the outside environment. The expression of doctrine is considered to provide an acceptable solution to the problem and the task was terminated.

PREFACE

Airmobile units operating in Germany queried the USA Land Warfare Laboratory (LWL) concerning the problem of providing cold weather protection for door gunners and crews of UH-1D/H helicopters. Liaison contacts with Army aviation units in Alaska revealed the same problem.

A development task was initiated to provide a kit to separate the door gunner's position from the rest of the aircraft, and to test various clothing ensembles for the gunner. The AAI Corporation developed the sliding door and bulkhead kit. USA Natick Labs provided advice on selection of clothing ensembles, and these were also tested at their facility. Mr. B.F. Wood, LWL, was the project engineer.

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INTRODUCTION

Brief History

The use of door gunners on UH-1 helicopters began with the introduction of those helicopters into the Vietnam conflict. Ambushing of landing sites and the infiltrating tactics of the Viet Cong and NVA troops led to the use of the door gunner as a counteraction. Initially gunners used "jury rigs" and field expedients, such as "bungee" cord, to support guns in the doors of helicopters. Later, kits were developed to mount the 7.62mm and 50 caliber machine guns in the doors of the UH-1D and following models. (See Figures 1 and 2 taken from Reference[1].)

Normally two guns are carried, one on each side (see Figure 2). The gunner sits on the jump seat and mans his gun as shown in Figure 3. Straps, other than those shown, are available which allow the gunner greater freedom of movement. The gunner has good azimuth coverage to the rear and front. The doors are opened and latched, which in the temperate Vietnam climate, presented no problem concerning the comfort of the occupants of the helicopter.

Problem Statement

In the cold weather the downwash of the rotor and forward air speed present the door gunner with a serious windchill problem.

Experience has shown that permanent freeze damage can occur if the gunner is not protected. Also, when the gunner is manning the gun, the entire crew and passengers are exposed to the cold.

Design Approaches

In response to the concern expressed by aviators in field units, a task was initiated by the USA Land Warfare Laboratory (LWL) to provide protection against the cold for the door gunners and crews of UH-1D/H aircraft. In keeping with Laboratory policy, a solution was sought that would not significantly add to material acquisition, maintenance, and training costs. The following design constraints were established:

1. No permanent modification to the aircraft would be accepted.

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[1]Department of the Army, Operators Manual Army Model UH-1D/H Helicopters, Headquarters, Department of the Army, 25 August 1971.

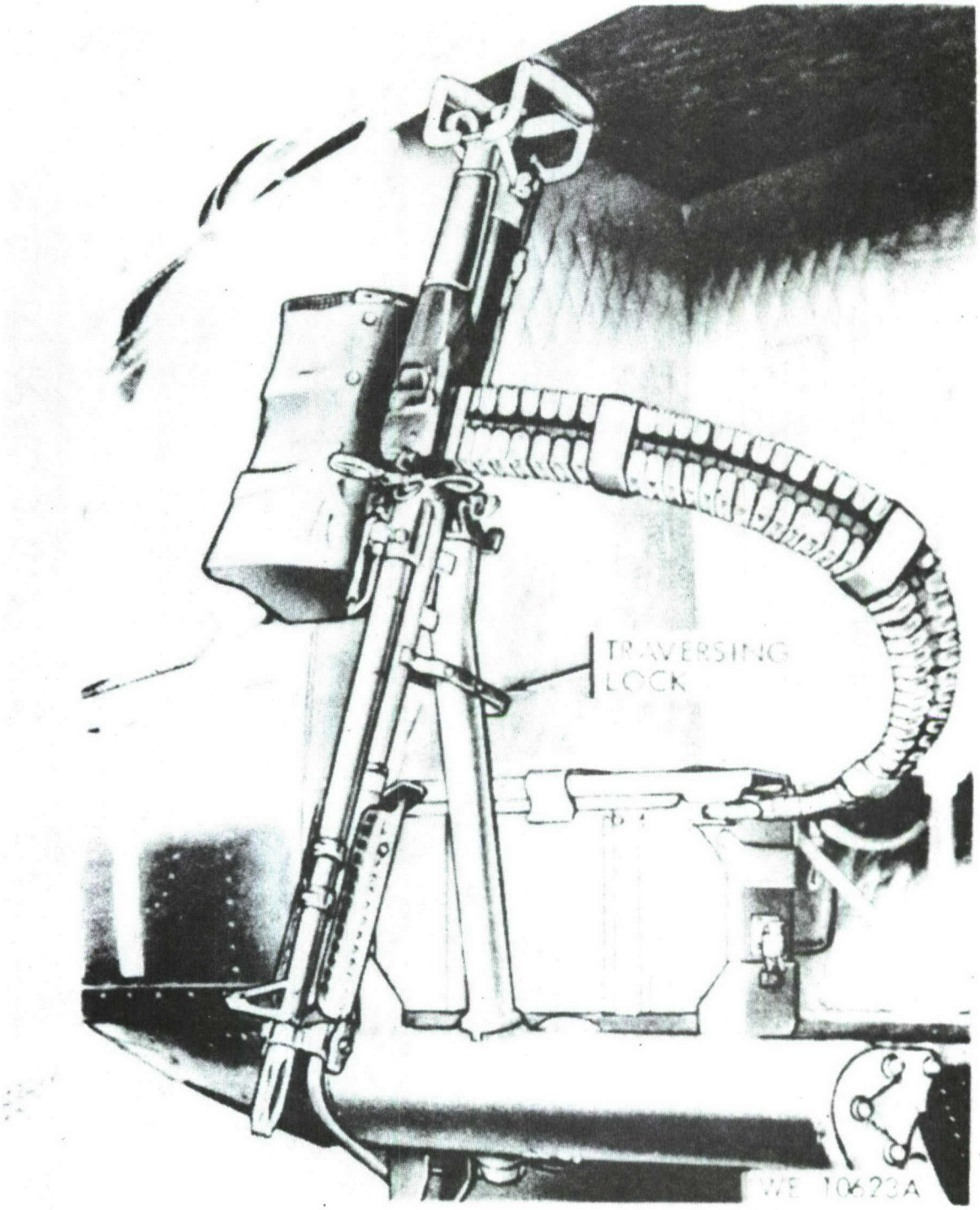

Figure 1. M60 Machine Gun in Stowed Position
Right Side Shown

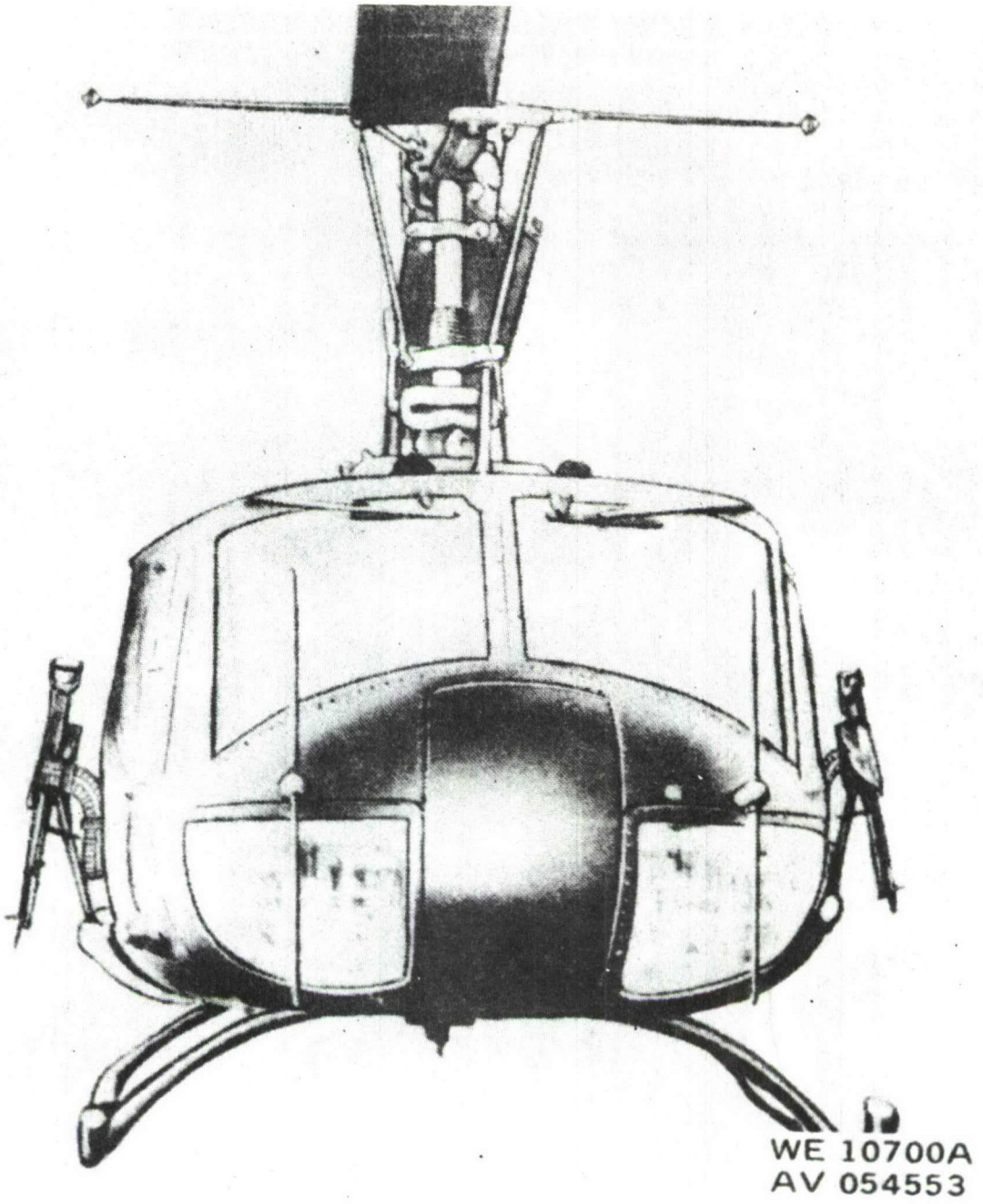

Figure 2. Armament Subsystem M23
Installation on Helicopter

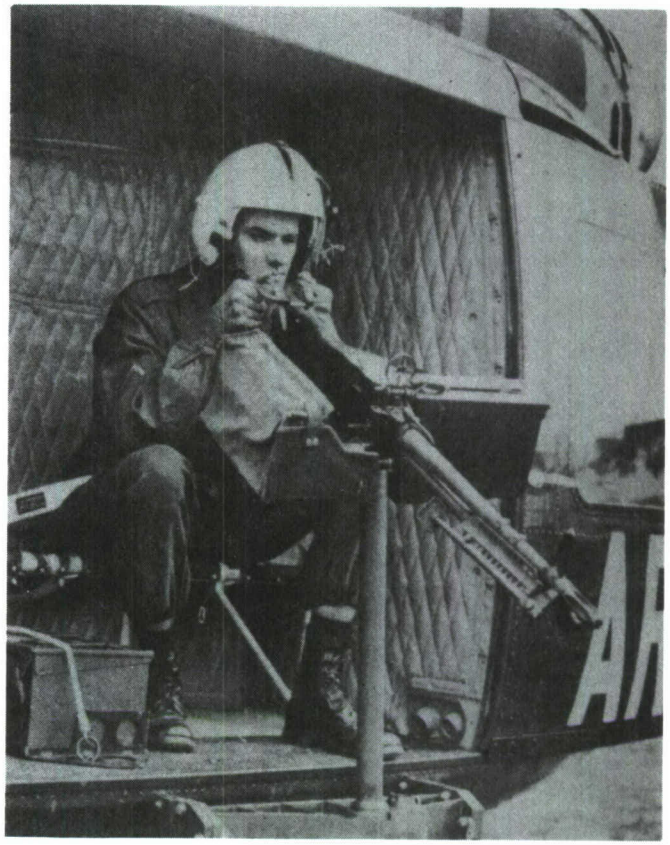

Figure 3. Door Gunner for UH-1D/1H Helicopters

2. No modification would be considered that would significantly compromise the operational efficiency of the aircraft.

3. No new gun system would be considered.

Among the design approaches considered were the use of a plastic bubble, a flexible plastic enclosure, and a means of rapidly opening and closing the rear window. These were all rejected principally because they interfered with the gunners' operations. Consideration was also given to the MINI-TAT gun system designed by the Emerson Electric Company and evaluated by MASSTER at Ft Hood, TX in June 1972.

As presented at the time, this belly-mounted, remotely-fired system appeared susceptible to freezing and jamming problems if operated in an arctic environment. With the knowledge that other US Army agencies would be giving full consideration to the MINI-TAT gun system, LWL eliminated this approach. The design approach selected involved the partitioning of the door gunner's compartment to protect the crew and passengers, and the insulation of the door gunner with protective or heated clothing as required.

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DEVELOPMENT

Protective Clothing

The Human Engineering Guide to Equipment Design[2] (Tables I, II and Figure 8) shows that the gunner will require heated clothing in the -65°F and 45 mph environment. The Guide also indicates that an individual suffering from the cold, even though he has not sustained frost bite, is probably ineffective at a task requiring concentration.

For these reasons, a warm-air heated garment was considered. The responsibility for the clothing part of the development was assigned to Natick Laboratories (NLABS), which had an ongoing development, known as the Micro-climate Suit, that appeared to be capable of satisfying the requirement. It had been demonstrated by NLABS that test subjects could perform in extreme temperatures with this suit without the weight incumberance of conventional arctic gear. The Micro-climate Suit was being developed in several modes:

1. With an umbilical hose for hot-air supplied from an external source.

2. With a power pack capable of supplying forced warm-air over a period of eight hours without refueling or replacement.

3. As an insulated garment without a heated air supply under milder conditions.

NLABS initially provided a Micro-climate Suit, a basic cold weather uniform as issued to troops in the arctic, and tanker's coveralls as issued to armor troops. Each uniform included a standard army aviator's helmet and the Micro-climate Suit included standard electrically heated gloves (without power pack).

Appendix A lists the components of the clothing ensembles. Before the field evaluation began, NLABS withdrew the Micro-climate Suit from consideration because it was in the development stage and not certified as being safe for the tests planned.

Closure Kit

The enclosure consisted of two sliding doors attached to a fixed vertical panel which in turn was connected to a bulkhead panel (with hinged door) situated between the gunner's compartment and the rear row of seats in the main compartment, (see Figures 4,5,6 and 7).

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[2]Joint Army-Navy-Air Force Steering Committee, Editors: Clifford T. Morgan, Jesse S. Cook III, Alphonse Chapanis and Max W. Lund, Human Engineering Guide to Equipment Design, McGraw-Hill Book Company, 1962.

Figure 4. Sliding Doors of Closure Kit

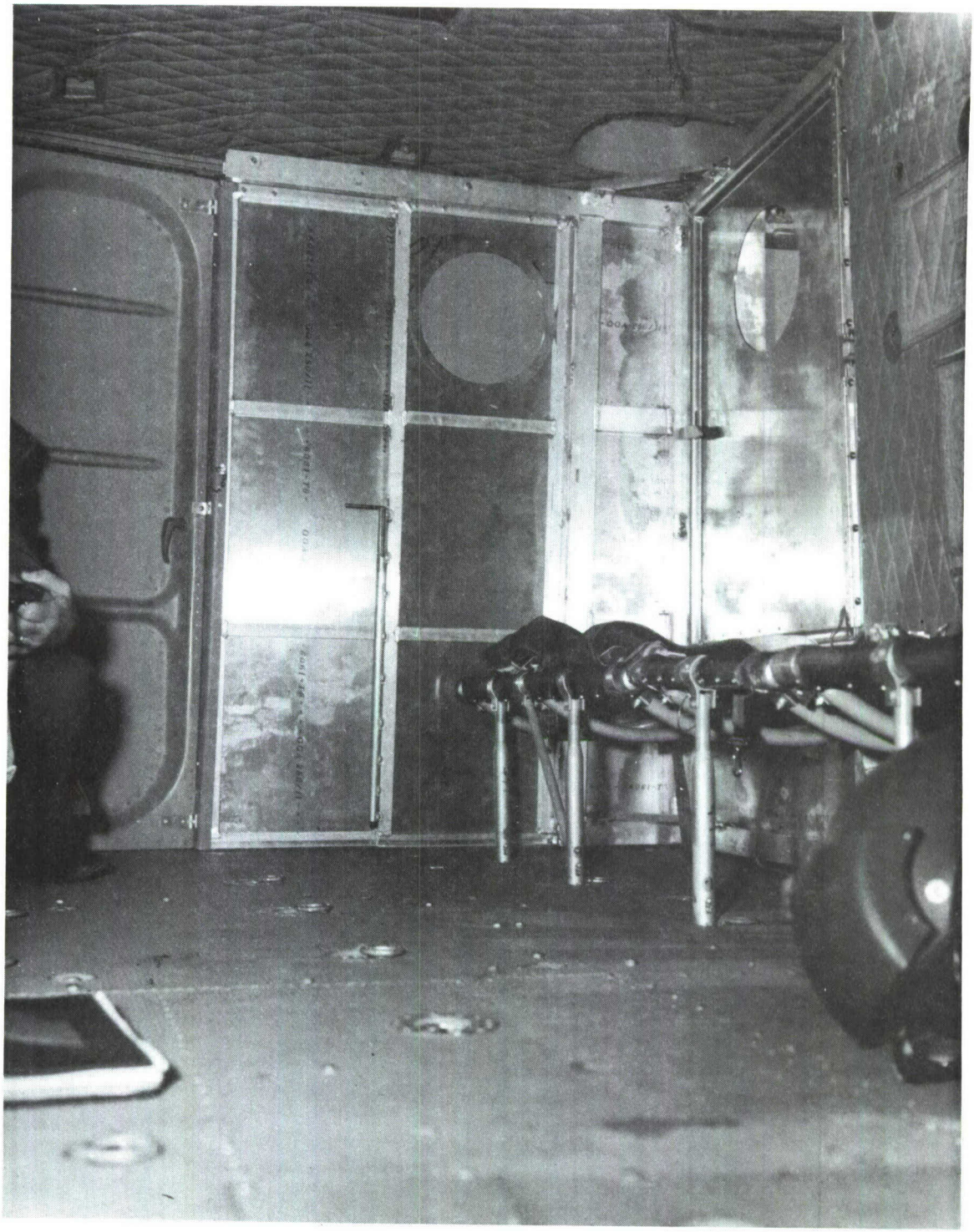

Figure 5. Interior View Showing L Hanger For Sliding Doors

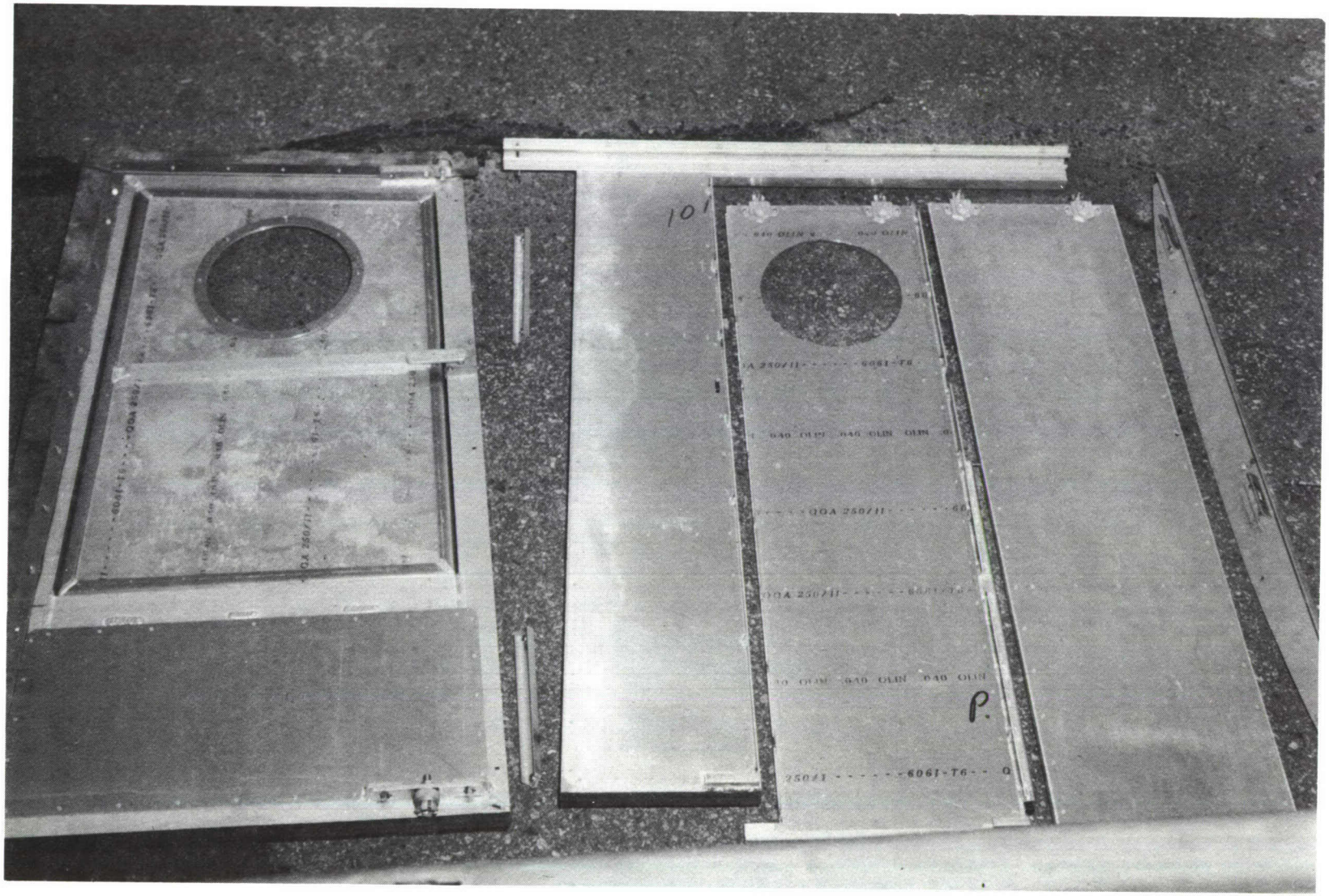

Figure 6. Closure Kit Disassembled

Figure 7. Helicopter Door Opened and Gunner in Position

Description of Operation

During an assault landing where door gunner protection is required, the suited gunner is in the door gunner compartment.

1. Before entering the danger area or descending to the landing zone, the aircraft is slowed to below 60 knots, the aircraft door is unlatched, and the closure kit doors are closed on the crew compartment and latched.

2. The door gunner pulls the aircraft door open and latches it in place. He takes his position behind the machine gun and the aircraft proceeds to the landing. (See Figure 7.)

3. Upon landing, the Closure Kit doors can be opened instantly to permit rapid debarkation of troops from the main cabin.

4. Upon take-off, the door gunner is in position. The Closure Kit doors are closed, and the aircraft door remains opened and latched.

5. After take-off and when clear of the danger area, the aircraft slows to below 60 knots, the aircraft door is slid forward and latched. The door gunner can enter or exit the main cabin from his station through a hinged door in the bulkhead panel.

TESTING

Testing of the Closure Kit at APG, MD

The Closure Kit was installed in a UH-1D/H aircraft. No modification to the aircraft was necessary.

Two test flights of 15 minutes duration were flown at 1000 feet. Aircraft speeds were 80 knots; ambient air temperature was 40°F, with winds of 12 knots. The aircraft was flown with the aircraft door open and in the latched position. The door gunner was at his station with the Closure Kit doors open as shown in Figure 7.

Flight observations established that the airlock seal from the gunner's position to the cabin area was acceptable. The Closure Kit sliding doors vibrated from the air stream and the vibration appeared to be reinforced by sympathetic aircraft vibration. Tightening of the floor stop on the doors (not shown in the photographs) provided sufficient damping to reduce vibration to acceptable limits. Side slip maneuvers were made in flight without noticeable problems in the Closure Kit. Wind velocity measured at the gunner's station showed that the gunner was subjected to winds approximately as shown in Table I.

TABLE I

Location	Fwd. Flight Cruise Velocity, 80 Knots	Approach & Take-off, 40 Knots	Hovering, Rotor Downwash
Hands on gun	80 knots	40 knots	20 knots
Legs and feet	60 knots	30 knots	15 knots
Head and torso	20 knots	10 knots	5 knots

Testing of the Arctic Clothing at Natick Labs

The insulation properties of four clothing ensembles were evaluated by instrumented sectional copper manikin tests in climatic chambers. The tests were conducted in the NLAB's arctic wind tunnel at a wind speed of 10 mph, and an ambient temperature of 0°F--to select the best clothing ensemble for a helicopter door gunner in the arctic.

The clothing ensembles dressed on the manikin consisted of: (1) the basic cold weather uniform; (2) the basic cold weather uniform with the trouser legs clamped at the back of the legs to simulate compression of the insulation over the knees when a helicopter door gunner is seated (since

the manikin is fixed in the erect position); (3) the basic cold weather uniform with electrically heated underwear substituted for the 50/50 cotton-wool underwear; and (4) the Micro-climate Suit without a hot/air supply.

The sectional and total clo* values for these clothing ensembles are shown in Table II. The clo values showed a 15% drop of insulation over the legs with the trouser legs in the clamped configuration - while the total clo values of the two configurations (clamped and unclamped) were the same. Apparently the excess material gathered at the back of the legs, and the restriction of vertical air flow, increased the effective insulation over the torso and hands sufficiently to maintain the same total clo value. However, the distribution of the insulation over the legs is of importance, and the loss of local insulation over the knees in excess of 0.5 clo is more serious than any benefits obtained by increasing the insulation over other areas of the legs or body. When the electrically heated underwear was substituted for the 50/50 cotton-wool underwear, the effective insulation over the torso-arms-legs sections of the manikins was more than tripled. However, the total insulation was only increased by about 85% because of the stabilizing effect of the insulation over the extremities. The total insulation of the Micro-climate Suit was about 20% less than the basic cold weather uniform; but more important, the insulation over the torso-arms, legs sections of the manikin was decreased by over 30%.

As expected, the heavier basic cold weather uniform provided better protection than the Micro-climate Suit without a hot-air supply.

Subsequent information from NLABS indicated that the unheated Micro-climate Suit could be modified or developed so its clo value would be equal to or greater than the standard arctic gear.

TABLE II. CLO VALUES FOR CLOTHING ENSEMBLES

Wind Speed = 10 MPH Ambient Temperature = 0°F

	ARCTIC WIND TUNNEL CLO VALUES						
Clothing Ensembles	Head	Torso	Arm	Hands	Legs	Feet	Total
Basic Cold Weather Uniform	0.93	3.1	4.5	7.5	3.6	2.3	2.9
Basic Cold Weather Uniform, Uniform/Trouser Legs Clamped	0.92	3.6	4.7	7.9	3.1	2.2	2.9
Micro-climate Suit (No Hot-Air Supply)	1.3	2.1	3.6	7.0	2.5	2.4	2.3
Basic Cold Weather Uniform, Electrically Heated Underwear	.96	11.0	64.0	14.0	9.0	2.2	5.3

* The clo is an insulation value of clothing which will maintain comfort for an individual at rest at room temperature.

Testing in Alaska

The Closure Kit and clothing ensembles (less the Micro-climate Suit) were tested by the 222nd Aviation Battalion at Ft Wainwright, Alaska, during February and March 1973.

The results of the Alaskan tests were essentially favorable. The doors of the Closure Kit were not tight enough to prevent some entrance of cold air. The clothing ensembles were too warm when the helicopter doors were closed. The aviator helmet used with both clothing ensembles did not give complete protection for the head. However, these deficiencies are minor and could be corrected. The Closure Kit functioned as intended, and the gunner was able to perform his task. The tests were not exhaustive and were not conducted at the low design-limit temperature of $-65^{\circ}F$. Lowest recorded temperatures during tests were $-20^{\circ}F$.

FINDINGS

1. The Door Gunner Closure Kit and associated clothing ensembles can provide cold weather protection for the crew, passengers and door gunners on UH-1 series helicopters without significant compromise of the gunners' efficiency or field of fire.

2. The litter-carrying capacity of a UH-1D/H series helicopter is limited by the use of door gunners with or without the closure kit.

3. Auxiliary fuel tanks cannot be used when door gunners are employed with or without the closure kit.

4. The use of the helicopter heating system and the wearing of arctic clothing in the closed helicopter were incompatible.

DISCUSSION

The development and evaluation of cold weather protection of door gunners of UH-1D/H series helicopters, and the resultant findings as noted above, brought to light a number of problems for resolution by the user. It became apparent during the course of the evaluation that if the passengers in the helicopter were expected to disembark and perform some function in the unprotected arctic environment they would require roughly the same protective clothing as the exposed door gunners. They, like the door gunners, would be uncomfortable in arctic clothing in a heated helicopter. Those realizations lead to the basic problem that the helicopter cabin was being heated solely for the benefit of the pilot and co-pilot who did not expect to leave the helicopter and therefore were wearing relatively lightweight flying suits. It was presumed that under operational circumstances the pilot and co-pilot would have available arctic clothing to put on in the event of an emergency. At the request of LWL, HQ, TRADOC developed the doctrine for the employment of UH-1D/H series helicopters under arctic conditions. It was specified that all crew members should wear arctic clothing suitable to the outside environment and TRADOC noted that the door gunners' exposure to the severe wind chill of the open helicopter need only last for a brief period during take-off and landing operations. Presumably the helicopter could then be heated or not heated in accordance with the comfort of all concerned. In addition to postulating the limited duration of the door gunners' exposure, HQ, TRADOC also stated that the return of the UH-1 helicopter to its utility role and the projected role of the UTTAS make it likely that door gunners would be required only on a limited number of missions. In accordance with the doctrine expressed by TRADOC the arctic clothing issued to the passengers and crew of a UH-1D/H-series helicopter can provide adequate protection during the limited exposure period involved.

CONCLUSION

Under the doctrine as recently expressed by TRADOC there is no requirement for a door gunner closure kit.

APPENDIX A

ENSEMBLE #1 (w. BASIC COLD WEATHER UNIFORM

APPENDIX A

ENSEMBLE #1 (w. BASIC COLD WEATHER UNIFORM)

BODY AREA	CLOTHING LIST, FSN/W DESCRIPTION
Head	Helmet, Flyers, Crash Ballistic Resistant, Nylon, K34252, FSN 8415-144-4981
Head Cover	Mask, Extreme Cold Weather, Nylon, Wool Felt, M12169, FSN 8415-243-9844, Class Q5 53
	Face Mask (Natick Lab design)
	Cap, Insulating, Helmet Liner, FSN 8415-782-2919
First Layer	Undershirt, 50/50 Cotton, Wool (full sleeve), FSN 8415-904-5136
	Drawers, 50/50, Cotton, Wool (ankle length), FSN 8415-904-5121
Second Layer	Wool, Shirt, Nylon Flannel, FSN 8415-188-3791
	Trousers, Cool Weather, Wool Serge, FSN 8415-231-7199
Third Layer	Liner, Cold Weather, Trouser, Nylon Quilted, FSN 8415-782-2926
	Liner, Cold Weather Coat, Nylon Quilted, FSN 8415-782-2888
Fourth Layer	Trouser, Extreme Cold Weather, Cotton, Nylon Wind Resistant, Sateen, FSN 8415-782-2954
	Coat, Cold Weather, Cotton, Nylon, Wind Resistant, Sateen, FSN 8415-782-2939
Outer Cover	Parka, Insulated, Extreme Cold Weather, Green Wrt, Fur Ruff, FSN 8415-890-2029

ENSEMBLE #1 (w. BASIC COLD WEATHER UNIFORM (CONT'D)

BODY AREA	CLOTHING LIST, FSN/W DESCRIPTION
	Liner, Extreme Cold Weather, Parka, Nylon Quilted, FSN 8415-782-2883
	Suspenders, Trousers, Scissors Back, FSN 8440-221-0852
Feet	Socks, Wool, Cushion Sole, Stretch Type, FSN 8440-782-2171
	Electric Heated Sock, Natick Design
	Mukluk, FSN 8430-269-0099
Hands	Gloves, Electric Heated, Natick Lab Design
	Mitten Shell Arctic, Gauntlet Style Shell, Leather Palm W/Trigger Finger, FSN 8415-926-1526

APPENDIX B

ENSEMBLE #2 (w. NATICK LABS ITEMS)

APPENDIX B

ENSEMBLE #2 (w. NATICK LABS ITEMS)

BODY AREA	CLOTHING LIST, FSN/W DESCRIPTION
Head	Helmet, Flyers, Crash Ballistic Resistant, Nylon, K34252, FSN 8415-144-4981
Head Cover	Mask, Extreme Cold Weather, Nylon, Wool, Felt, M12169, FSN 8415-243-9844, Class Q5 53
	Face Mask (Natick Lab Design)
	Cap, Insulating, Helmet Liner, FSN 8415-782-2919
First Layer	Undershirt, 50/50 Cotton, Wool (Full Sleeve) FSN 8415-904-5136
	Drawers, 50/50 Cotton, Wool (Ankle Length), FSN 8415-904-5121
Second Layer	Wool, Shirt, Nylon Flannel, FSN 8415-188-3791
	Trousers, Cold Weather, Wool Serge, FSN 8415-231-7199
Third Layer	Natick Labs Tanker Suit Liner
Fourth Layer	Natick Labs Tanker Coveralls
Feet	Socks, Wool, Cushion Sole, Stretch Type, FSN 8440-782-2171
	Electric Heated Sock, Natick Design
	Mukluk, FSN 8430-269-0099
Hands	Gloves, Electric Heated, Natick Lab Design
	Mitten Shell, Arctic, Gauntlet Style Shell, Leather Palm W/Trigger Finger, FSN 8415-926-1526

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